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A Typology of Foreign Exchange Auction Markets in Sub-Saharan Africa

Janine Aron
Ibrahim Elbadawi

Transparent policy rules and conduct are of paramount importance to the success of foreign exchange auctions.

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Summary findings

Aron and Elbadawi compare and contrast the design and outcomes of different foreign exchange auctions in four countries in Sub-Saharan Africa and present a typology of such auctions.

They identify two distinct sets of countries in terms of the auctions' features, policy interventions, and outcomes.

In Ghana and Uganda, the exchange rate auctions are judged to have been largely on target in exchange rate unification, exchange rate stabilization, and efficient allocation of foreign exchange.

The auctions in Nigeria and Zambia, on the other hand, were subject to frequent policy interventions, resulting in unsustainable auctions, inefficient allocation of foreign exchange (through ad hoc disqualifications), limited unification, and a rather volatile exchange rate.

The conclusions reached by Aron and Elbadawi are broadly corroborated by a statistical analysis of weekly micro-auction data for all four countries.

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1. INTRODUCTION

Following the economic crisis that impacted Sub-Saharan Africa (SSA) from the second half of the 1970s, the unification of exchange rates (official and parallel)[1] and integration of parallel markets into the official economy, has been a major policy objective for reforming African countries. The extent of macroeconomic imbalances (especially fiscal) that have prevailed in SSA and the rudimentary nature of economic institutions (such as the banking system), provide a strong case for a gradualistic approach for exchange rate unification in SSA. In this context, centralised multi-unit auctions for foreign exchange were introduced from the early 1980s in SSA as a transitional medium towards a credible and sustainable unified regime (such as an efficient, decentralised interbank market). A brief overview of the structure of foreign exchange markets in SSA (including auctions) is contained in sub-section 1.1 below. Further, sub-section 1.2 provides a discussion on the objectives and rationale for the choice of foreign auction markets as an initial component of the exchange rate unification reform in SSA.

The objective of this paper is to conduct a basic analysis of auction data to explain the different outcomes regarding the auction objectives (e.g. exchange rate unification) that have been observed in SSA. This paper studies foreign exchange auctions in four African countries: Ghana, Nigeria, Uganda and Zambia. The auctions' periods covered by the study are: 19 Sep. 1986 to 5 March 1992 for Ghana, 26 Sep. 1986 to 24 Nov. 1988 for Nigeria, 31 Jan. 1992 to 7 May 1993 for Uganda, and 11 Oct. 1985 to 24 Jan. 1987 for Zambia. While auctions in Ghana and Uganda are generally considered to have been fairly successful, those of Nigeria and Zambia proved unsustainable or produced considerable exchange rate volatility. We hope that the typology of auctions developed in this paper will help to inform the improved design and conduct of auctions at the micro-level. A further objective of this paper is to provide the background for a more rigorous analysis in a companion paper (Aron and Elbadawi, 1994), which models the micro-determinants of the auction rates for the above four countries, and tests some policy propositions motivated by auction theory.

1.1 Multiple Foreign Exchange and Auction Markets in Sub-Saharan Africa

For most SSA countries, exchange rate policy was static from Independence until the 1980s, playing no role in balance of payments adjustments. The fixed exchange rate regimes of the 1960s and early 1970s appeared to be viable, given consistent macroeconomic policy and a relatively favorable external environment. By the second half of the 1970s, however, these economies had been weakened by public expenditure booms (exhibiting ratchet effects) following the positive shocks in oil and commodities markets. Adverse and persistent terms of trade (TOT) shocks from the mid-1970s further drained foreign exchange reserves in many SSA countries, bringing their exchange rate regimes under pressure. In most cases, the overvalued exchange rates were defended by the rationing of foreign

[1] The term unification in the SSA context refers to eradication of the parallel market. However, since these countries are likely to maintain capital controls in the medium term, there would remain a small role for the parallel market in meeting portfolio demand. Our concept of unification in SSA is thus a substantial reduction of the parallel market so that it is no longer a major signal in the economy.

exchange, and more stringent capital and import controls were imposed. One consequence was a burgeoning of illegal, parallel markets in foreign exchange.

Parallel markets in SSA have shown a tendency to expand rapidly. In contrast to most Latin American countries, where small quasi-legal black markets operate as a sideline to official multiple markets with premia typically below 60 percent, illegal black markets in SSA are major markets, with substantial premia. Of the ten SSA countries considered by Kiguel and O'Connell (1992), the average parallel premium for 1970-89 exceeds 90 percent for six countries, and 150 percent for two countries.

Since the 1980s, the current and long-run costs of multiple markets for foreign exchange have been increasingly emphasized by multi-lateral donors and governments. The negative macroeconomic implications of official multiple markets (the Latin American case) largely hold for official/unofficial multiple markets (the SSA case) (Kiguel and O'Connell, 1992). However, the African case must be distinguished by the prominent role for illegal markets. The large size of unofficial markets and of premia means there is considerable diversion of trade and productive activity into illegal channels, with a narrowing of the tax base. Domestic prices may largely be determined in parallel markets and strongly influenced by changes in the parallel premium. Flight from domestic currency reduces the savings base for domestic investment, presenting a severe constraint on long-term growth. Another consequence is wide-spread speculative activity. There is clearly a strong case for the elimination of parallel markets.

The question remains how a sustainable unification of multiple markets might be achieved. Flexible exchange rate arrangements to this end have characterized most I.M.F. and World Bank-supported programs since 1983 (Quirck et al, 1987). These fall into two categories: interbank markets in foreign exchange,[2] and a number of innovative experiments using foreign exchange auction markets.[3] Potentially these market-determined exchange rates hold a number of advantages for countries with thin foreign exchange markets over non-market alternatives, such as the crawling peg. They are efficient in rationing foreign exchange and reduce manipulation in thin markets; can allow a more certain path for reserve management; avoid the choice of the appropriate exchange rate, and can serve to distance the government from the political costs of devaluation (Krumm, 1985).

Auctions may have advantages over interbank markets where there is insufficient institutional depth to allow effective functioning of a decentralized foreign exchange market, where a few commercial banks have historically been dominant and there is a danger of collusion, or where there are limited sources of foreign exchange.[4] Given the structural characteristics of Sub-Saharan African countries, therefore, auctions potentially have an important role to play in exchange rate unification,

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[2] Countries which have used interbank markets include Zaire, The Gambia, Sierra Leone and Nigeria (in tandem with an auction).

[3] Countries which have established various types of exchange rate auctions include Bolivia (1985 onwards), Jamaica (1984-89) and African countries, Ghana (1986-92), Nigeria (1986-94), Guinea (1986-), Zambia (1985-87), Sierra Leone (1982-83), Uganda (1982-85, 1992-93) and Ethiopia (1993-).

[4] There are disadvantages too in the increased administrative requirements of a centralized system, the potential for government manipulation of the exchange rate or for rent-seeking, and a closer association of the government to the politics of the exchange rate.

primarily as a transitional device to an efficient interbank market.[5] Yet to date there is little understanding of the functioning of auction markets in Sub-Saharan Africa, and there has been virtually no research on the causes of frequent policy reversals or auction failure. Apart from supply problems due to initial conditions of market thinness and vulnerability to terms of trade shocks and fluctuations in the disbursement of foreign aid, potential causes of failure include macroeconomic laxity, inappropriate auction design and poor micro-management of auctions.

1.2 The Rationale for Transitional Foreign Exchange Auctions in SSA

The principal objective of exchange rate liberalisation in SSA is unification of multiple exchange markets into a single market, or at least to narrow significantly the gap between the rates, so that the free/black market premium no longer constitutes a major signal in the economy. This objective of a realistic exchange rate which reflects market conditions, initially has far greater priority than a second objective, that of stabilizing the exchange rate. Stabilization is crucial in some Latin American economies, where the parallel market is small relative to the official market, and where the feed-through coefficient from official devaluation to inflation in near hyper-inflationary conditions is very high (0.6 for Bolivia (Dominguez, 1991)). In SSA many prices already reflect the parallel exchange rate, so that official devaluation is unlikely to have a significant effect on inflation (Aron and Elbadawi (1992)). Stabilization in SSA will assume increasing importance as real depreciation is achieved. Nevertheless, reducing volatility in the transitional period is also desirable for all the usual reasons: in SSA, exchange rate volatility has been shown to be the most important deterrent for investors. Volatility is in part related to a limited supply of foreign exchange, which is based on highly concentrated exports of primary commodities, vulnerable to TOT shocks, and on donor aid, also subject to shocks.[6]

A third important (and perhaps underestimated) objective is the restructuring of domestic production through a market-determined allocation of foreign exchange. Allocation according to competitive market valuations should allow scarce foreign exchange to be utilized in an efficient manner. Damaging distortions were introduced by the practice of manual allocation, with favoritism and incentives for wasteful rent-seeking activities. Moreover, the system perpetuated large, inefficient parastatals, which have proved a drain on scarce foreign exchange and on the budget.

Given the rudimentary nature of many markets in SSA, and of institutions such as the banking system, auctions potentially have an important role to play in the establishment of deeper and more stable markets in the transition to efficient, decentralised interbank markets. Auction markets have two advantages over interbank markets in constraining volatility in thin markets. First, they may be feasibly operated in conjunction with a stabilization fund, which can commit supply in the medium-term and still offer a market-based rate. Secondly, auctions are informationally-rich, and this may be

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[5] This is how the relatively successful and lengthy unification experiment in Ghana progressed.

[6] Destabilising capital inflows are constrained by the capital controls present in most SSA countries and are likely to be maintained for the medium-term. There may be considerable outflow from capital flight, however (Aron and Elbadawi, 1992).

exploited by the seller in two ways. By appropriately revealing information or adjusting the reserve price and supply, uncertainty may be reduced, speculative pressures stemmed and collusion limited, hence stemming volatility. On the other hand, auctions give the seller information about private agents' valuations; in signalling demand pressures auctions can be used to enhance monetary management.[7] This was found to be a principal advantage of the auction in Bolivia (Dominguez, 1991). This macro-micro interaction resulting in improved monetary management also enhances the credibility of auctions.

An auction system has significant advantages over the interbank system in allocation of foreign exchange in thin markets. There is no reason to assume that a fair and efficient allocation will occur where predominantly state-owned banks or a highly concentrated commercial banking sector allocate foreign exchange to final customers (after a wholesale auction of export proceeds, or a decentralized purchase of export receipts). Indeed, practice shows otherwise: in a concentrated sector, the banks possess considerable allocational autonomy, with favored customers and bank shareholders first in line. Auctions offer the possibility of restricting entry through a set of rules which reflect development priorities, but still maintain market-allocation. These rules can be liberalized over time. Thus, for example, foreign exchange for luxury goods can be limited to repatriated flown capital. The problem of an asymmetric set of importers, differentiated by credit-worthiness and production costs, could be addressed in a number of ways, for instance by cumulative caps on allocation for very large users of the limited supply of foreign exchange, at least for a transitional period.

Thus, the significant advantage of auctions in SSA is that they offer an informationally-rich framework and the possibility of gradually liberalizing auction restrictions in the progression toward deeper and more competitive financial markets. Unfortunately, associated with this strength is the license it offers governments to manipulate an auction and to engage in ad hoc interventions. This is the main reason for the current disaffection with auctions amongst some within the donor community. This point has to be addressed squarely, and we believe that there is scope to design transparent auctions which reduce manipulation by the seller.

The structure of the rest of the paper is as follows. Section 2 gives a typology of foreign exchange auctions in the four countries. A detailed statistical analysis of micro-auction data from the above four auctions is contained in section 3. Section 4 contains a brief macroeconomic interpretation of the auctions' outcome. Section 5 concludes.

2. DESIGN CHARACTERISTICS OF AUCTIONS IN SSA

The design characteristics for the Zambian, Ugandan, Ghanaian and Nigerian auctions are summarized in Table 1. These case-studies present a wide spectrum of auction designs and outcomes

[7] It might be argued that a black market or foreign exchange bureaux market offers the same signalling advantages as an auction. This is false: these markets are very thin markets and reflect the influence of remaining trade restrictions and exchange controls, as well as various demand pressures not consistent with development priorities, such as smuggling activities.

for cross-country comparisons. In three of the countries, different auction types follow consecutively, allowing within-country comparisons of auction design. In this section we compare and contrast auction designs and outcomes across countries, and motivate hypotheses concerning the effect of auction design on the achievement of policy objectives such as stabilization of the exchange rate, and unification of multiple exchange markets. Some of these hypotheses will be tested in a second companion paper (Aron and Elbadawi, 1994).

2.1 Duration and frequency of the auctions

The various auction experiments have spanned widely different periods. In Ghana, weekly auctions of varying design were held over almost 6 years, and then replaced by an interbank market, with decentralization of the sale of most export receipts. The same result has been achieved in Uganda, although after a considerably shorter period of auctions (about 21 months). In both these countries the auctions proceeded fairly smoothly, and the rules were gradually liberalized over time. By contrast, an 18-month experiment in Zambia with 68 weekly auctions, saw restrictions tightened over time and frequent rule changes. The auctions were suspended for three months; subsequently a further 6 auctions were held, but a speculative run on the kwacha saw the system abandoned, with a return to a fixed exchange rate regime. In Nigeria, auctions have similarly yielded mixed results, and have been subject to considerable rule changes. Auctions were held over six years, weekly for the first 67 auctions, during 1986-88; then daily during 1989-90, in conjunction with an interbank market; a weekly system was again initiated early in 1991, and continued until early 1994, when the exchange rate was fixed. The competitiveness of the 1989-90 auctions in Nigeria is in doubt: participants were guaranteed a maximum allocation regardless of their bids. We therefore examine only the 1986-88 period.

There may well be a relationship between the duration of the auction regime and the success of the outcome, though this will obviously depend on the initial depth of the financial and foreign exchange markets. Admirers of the Ugandan and Ghanaian outcomes suggest that a slow and unambitious start, together with gradual expansion of the auctions through liberalization of the rules, served both to facilitate institution-building and learning, and to enhance the credibility of the reform. However, auction stability in these countries is also importantly related to other design features, such as transparency and the use of a reserve price, both of which were hallmarks of the Ugandan and Ghanaian auctions.

A higher frequency of auctions would seem desirable since this could smooth disbursement, make firms' production more flexible, and probably encourage investment. Further, the speculative behavior or over-bidding that might occur in more sticky markets would be curtailed. On the other hand, a high frequency auction market may be so thin that the marginal price would probably not be a useful guide to the exchange rate, and would in any case be rather volatile between auctions. Further, there may be increased incentives for collusive behavior amongst bidders. For the SSA auctions under consideration, weekly or bi-weekly frequencies were employed, and in general the demand for foreign exchange exceeded the supply in fairly deep markets.

2.2 Pricing

Two types of pricing mechanisms have been used in these auctions. These are the discriminatory or Dutch auctions, where bidders pay their own price for each unit; and competitive auctions, where bidders pay the lowest accepted bid price for each unit. The clearing rate for all the auctions was defined as the marginal rate at which the available supply is exhausted, when ordering the bids from the highest to the lowest price. All four countries used the Dutch auction, although the first auction in Ghana used competitive pricing, and Zambia and Nigeria preceded their Dutch auctions with, respectively, 42 and 24 competitively-priced auctions. The stated rationale for the choice of Dutch over competitive pricing was two-fold: raising revenue through discriminatory pricing; and the disincentive toward depreciation thought by some policy-makers to be embodied in the Dutch pricing. While there is no theoretical justification for the latter view, the former proposition has proved controversial in the auction literature (e.g. the U.S. Treasury Bill auction debate). There are also potential disadvantages to Dutch pricing: first, if there is a large spread between bids, this may be construed as constituting a multiple exchange rate system, with the attendant disadvantages (Quirck, 1987); and secondly, a smaller pool of bidders may ensue because the Dutch auction introduces a barrier to entry for risk-averse bidders who are poorly informed about market developments (Goldstein, 1962). Theory predicts that Dutch pricing lessens collusion (Robinson, 1985); but some authors are of the view that through a narrower range of bidders, Dutch pricing may also encourage collusion (Quirck et al, 1987). Given that Nigeria and Zambia included both types of auction, some of these issues could be subject to empirical verification.

The official buy and sell exchange rates for all these countries were closely based on the clearing rate. Where an interbank market operated in conjunction with the auction (e.g. Nigeria), the buy/sell rates in this market were constrained to lie within some margin of the auction rate.[8]

2.3 Competition and the nature of bids

Two types of sale have been employed in the SSA foreign exchange auctions. In the retail auctions, the bidders were private and public sector importers, and bids were channelled through commercial banks. In some cases the rules were liberalized to allow the banks to compete for their own requirements. This system was used in Zambia, and for 174 auctions in Ghana. The Central Bank opened sealed bids for each importer, specifying the quantity of foreign exchange desired, the price that the importer was willing to pay for it and the intended usage of the foreign exchange. These auction markets attracted between 100 and 600 bids, with the potential for a competitively-determined exchange rate (the numbers of bids are shown in Table 2).

By contrast, in the wholesale auctions used in Nigeria and Uganda, and later in Ghana, the bidders were registered banks or foreign exchange dealers. The system adopted in Nigeria initially allowed an unconstrained secondary market for foreign exchange, so that banks competed freely in the auction for later resale to importers in the interbank market (see Table 1). Each bank submitted

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[8] If a reserve price is used (see sub-section 2.5), a quantity-weighted average of the reserve price and the bids above it could determine the exchange rate. This was the practice in Bolivia.

one bid. In Uganda and Ghana (1990-92), the banks were constrained to submit aggregated quantity bids at the various prices bid by importers (and possibly themselves). The number of bids opened by the Central Bank to determine the clearing rate in either case was thus far smaller than in the retail auctions (Table 2).

The danger in the Nigerian scenario, is that allowing banks full autonomy in bidding for and then dispensing foreign exchange in a secondary market, could, in concentrated financial markets, lead to collusion. Banks could offer bids below their own value of the foreign exchange, but resell at the market price, thus widening the spread between the buy rate (i.e. the auction rate) and secondary (interbank) market sell rate, with rents accruing to the banks. This appears to have occurred in Nigeria, obviously defeating the objective of unification. Moreover, it is not obvious that the subsequent allocation to final customers would be optimal: indeed anecdotal evidence from Nigeria suggests that the bank's shareholders and favoured customers had privileged access to foreign exchange in the secondary market[9]. Auction theory advises that auction managers employ a reserve price (below which foreign exchange will not be sold) to combat suspected collusion (McAffee and McMillan, 1987). A reserve price was not employed in Nigeria.

Under the strict monitoring of the wholesale system used in Ghana and Uganda, the low number of composite bids need not have affected the potential for a competitively determined auction rate. Nevertheless, the possibilities for collusion do seem to be greater, given the reduced transparency of the system. Both Uganda and Ghana used an unannounced, though fairly predictable, reserve price, around which the bids clustered over time. Thus, the clearing rate was influenced with reference to some target, so that the system resembled a crawling peg, though with a market (not manual) allocation of foreign exchange. This convergence of bids (see Table 2) could either have represented the bidders learning the reserve price rule over time; or possibly collusion amongst bidders. The reserve price is discussed further in sub-section 2.5 below.

2.4 Entry and allocative restrictions

A limited supply of auctionable funds, and significant excess demand has in practice been used to justify entry barriers on grounds of allocation. Typical entry barriers are: confining the use of foreign exchange to particular sectors; confining the use of foreign exchange to particular types of imports (typically excluding luxury goods); and limiting participation by commercial banks, licensed foreign exchange bureaux and the state-owned sector (e.g. with ceilings on their maximum allowable allocation, or complete exclusion from the auction). To enforce these various exclusions, bidders are monitored through documentation requirements, such as evidence of paid up tax, deposits with the commercial bank filing the application, and import and export invoices. An unintentional entry barrier has in some cases been posed by the varying credit-worthiness of bidders in imperfect financial markets. All the SSA auctions required a local currency cover for bids, and some smaller companies apparently found their access unfairly restricted (e.g. in the Zambian and Ugandan auctions).

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[9] The existence of considerable rents in the Nigerian auction is reflected in the proliferation of licenced banks, which increased in number from 41 in 1986 to 112 by early 1991.

One trade-off with entry barriers, is that transactions costs for bidders in terms of the time involved in preparing bids may impose a disincentive to use of the auction, and it is obviously important to streamline the license and bank applications procedure. It also seems clear that efficiency would be enhanced if there were reduced sectoral constraints. On the other hand, the non-eligibility of some consumer and luxury items seems reasonable, at least in the early stages of an auction regime, when it may be vulnerable to speculative pressures.

Another problem arising with entry restrictions is that where barriers are not clearly defined, they effectively decrease transparency in the auction, granting license to the authorities to manipulate the set of bidders. In Zambia, disqualifications were ad hoc at various times in a deliberate attempt to suppress depreciation. Apart from the non-market pricing and allocation this may induce, the perceived credibility of the reform may be jeopardised (see also sub-section 2.6).

Expanding an auction through the liberalization of various barriers to entry will increase competition, and therefore bid prices, as importers previously satisfying needs on the parallel market or bureaux de change (or not at all), move into the auction. While the auction rate is expected to increase, the volatility of the rate over time may decrease, due to a more competitive and credible system. Auctions where entry restrictions were increased over time (e.g. Zambia and Nigeria) seem to have traded a less depreciated real rate for increased volatility and a larger black market premium.

A paramount reason for the success of the Ghanaian auctions was a gradual widening of the auction system, combining trade and exchange rate liberalisation. This served to increase competition and foster confidence in the system, deepening financial markets by allowing institution-building over time. A two-tier system operated for about six months: when these windows were unified in early 1987, all transactions were settled through the auction market. Access to the auction was widened thereafter through a step-wise inclusion of additional goods and services, while import restrictions were relaxed. By early 1988 virtually all consumer goods were eligible, and import licensing finally abolished by early 1989. Current invisible payments were liberalized over the same period. The foreign exchange bureaux were legalized early in 1988, and late in 1989 allowed to bid in the auction with the commercial banks, on behalf of final users. At the same time, decisions concerning the eligibility of auction bids was transferred to the commercial banks and eligible bureaux. Finally, the sale of non-cocoa exports were decentralized to the banking sector in early 1991. These moves paved the way for the transition to a less concentrated interbank market, less liable to collusive practices. Uganda similarly successfully liberalized the set of restrictions on imports and bidders over time.

Finally, an important question is whether the state sector should be included in the auctions. It would be naive to ignore the political economy of public enterprises. With fixed exchange rates, and manual allocation of foreign exchange, parastatals are the principal beneficiaries of exchange rate rents. As large employers, parastatals have a powerful political voice; they may also impose internal party pressures on the government (as occurred in Zambia). This suggests that shock therapy resulting in the rapid demise or even bankruptcy of parastatals is to be avoided. In anycase the negative impact on the budget of such an event could be significant. On the other hand, there are significant allocational gains to be had from not perpetuating such a system. In Uganda, Ghana and Nigeria, state enterprises competed in the auction and received no prior allocations. With the change of the Nigerian

auction system in 1989, however, public enterprises again had direct access to foreign exchange though the Central Bank. In Zambia, the largest parastatal by far, the state copper mining company, received allocations outside the auction. Other parastatals were included from February, 1986, but the heavy users of foreign exchange, the oil and airways state companies, bid competitively for only a few auctions, and were then allocated on average 40 percent of the auctioned foreign exchange at the marginal rate. Thus, a crucial determinant of supply to the private sector was the privileged allocation to the state sector: only about 25 percent of total foreign exchange inflows were actually auctioned in Zambia during 1985-87.

2.5 Informational rules

There are three ways in which information could be revealed by the auction managers: first, the use of a (fairly predictable, or possibly pre-announced) reserve price, which reflects the authorities value of the auctioned foreign exchange; secondly, pre-announcement of the supply of auctionable foreign exchange, or commitment of supply over the medium-term; thirdly, publication of the nature and/or number of bidders/composite bids. These are considered in turn.

Auction theory recommends the use and pre-announcement of a reserve price, particularly where bidders' valuations of foreign exchange are "affiliated" (where one bidders's high value makes more likely a high valuation in other bidders). There is probably an element of affiliated values in foreign exchange auctions, and it is then to the seller's advantage to provide information about the value of the auctioned item. The authorities' value of the auctioned item may be fairly easy to assess if there are well-developed secondary markets for it (e.g. as for some Treasury Bill auction markets). Parallel foreign exchange markets (legal or illegal) were present for all the SSA auctions, but except in the case of Nigeria these were not resale markets. These parallel markets, at least initially, were typically thin and restricted markets: the black rate, in particular, being subject to various influences making it an undesirable anchor (see Aron and Elbadawi, 1992). Uganda and Ghana legalised the parallel market (as the bureaux market) and encouraged its deepening over time. Interviews have suggested that these bureaux markets were used as a guide in reserve pricing. Both these countries used unannounced reserve prices, while Zambia and Nigeria did not use reserve pricing. The stabilizing effect of such a "crawling peg" system is apparent from the Figures 1a-d, and contrasts with erratic behavior of the exchange rate in the other two countries. The dramatic fall-off of the bid-spread over time in these two countries (Table 2) suggests that bidders may have learnt the reserve price policy rule, and bid more efficiently. If a reserve price is used, there may be a transparency advantage in announcing it each week just before opening the bids.[10]

There may be similar stabilizing advantages to pre-announcing supply and sticking to it. Pre-announcement (just before opening the bids) occurred for all auctions in Nigeria. In Zambia, a general

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[10] This was the practice in Bolivia: the reserve price and supply were announced only after the sealed bids were in. It is important to note though that only in 107/1107 days did demand exceed supply (the average daily auction supply over five years was $5.4 million). This rather contrasts with the SSA auctions, where excess demand was mostly the order of the day. Further, with small parallel markets and near hyper-inflation, stabilization of the rate, rather than unification, was Bolivia's primary objective.

ceiling of $5 million was declared for auctions 1-19, raised to $9 million for auctions 20-52, and dropped to $5.5 million for auctions 53-68; but except for auctions 55-68, this bore little relation to actual supply (Table 1). Both Zambia and Nigeria were subject to sharp appreciations through periodic massive disqualifications of bids. Supply was not announced in Ghana, and was volatile (Table 2). Supply was announced only just prior to opening the bids in Uganda, but while pre-announced supply was fairly constant, actual supply was fairly volatile (Table 2). It seems likely that an uncertain supply could foster uncertainty and place a premium on the amount bid, in the absence of a predictable reserve price. It would thus be interesting to test the impact of supply volatility on the behavior of the marginal auction rate.

The publication of bids occurred weekly in Zambia, listing each importer's bid, by quantity, price and use, for auctions 37-68. Uganda published the list of composite bids by price and quantity, indicating disqualifications. Nigeria and Ghana did not publish details of the auctions. Whether the spectrum of bids should be published has no clearcut answer: it may create confidence through transparency, and enhance learning, which were the intentions in Zambia. On the other hand, when the number and nature of bidders becomes known, this may foster collusion in repeated, sequential auctions. Collusion is less likely to matter in an auction with a large number of bidders, however.

2.6 Transparency

An important lesson from the Zambian auction is that if there isn't transparency in the auction, it is probably pointless holding one. The degree of transparency of rules and management differed across the auctions. Transparency was poor in Zambia and Nigeria. Ad hoc interventions and frequent rule changes by auction managers were an important cause of instability, fostering uncertainty, incredibility and resulting in poor (non-market) allocation. The auction rules in Zambia actually stated that the Central Bank had license to disqualify any bid without having to give any reasons: this was a serious design fault.[11] Auctions in Ghana and Uganda were operated with transparently, with clear rules, and the public opening of the bids. The management committee in Ghana did not only consist of Central Bank personnel, but included representatives from the private sector. There was fairly broad consultation on changes in the Central Bank's regulations for the auction, which were published as amendments.[12]

3. A STATISTICAL ANALYSIS OF MICRO-AUCTION DATA IN SSA

This section examines the evidence on the evolution of the auction rate and other auction variables for each of the four African countries. The objective of this section is to use characteristics

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[11] This was exercised in auction 41, for instance, where all bids larger than 8 kwacha/$ were arbitrarily declared to be disqualified.

[12] An interview at the I.M.F. in 1993 revealed that foreign exchange auctions in Romania and Khazakstan were at that time less than transparent, and that this was proving debilitating to the functioning of the auctions.

of auctions data to draw some empirical regularities: (i) to account for the behavior of the auction rate in terms of the impact of various fundamentals, as well as policy intervention, policy credibility and uncertainty; (ii) to attempt to link particular data characteristics to different outcomes, regarding the auction objectives (e.g. exchange rate unification); and (iii) to inform a further and more rigorous analysis on testing theoretical propositions from auction theory (Aron and Elbadawi, 1994b). The analysis of this section is centered around three broad methodological issues. First, basic summary statistics for each country will be analyzed for the overall auction period as well as for the episodes identified in section 2 above. Second, the distributional properties of the auction variables will be studied, focusing on the extent to which innovations from these variables exhibit departures from non-normality. Third, the section concludes with a discussion of stationarity issues of individual auction or data series.

3.1 Standard Descriptive Statistics.

Table 2 provides basic summary statistics of auction data from Ghana, Nigeria, Uganda and Zambia, on prices, price spreads, foreign exchange quantities, number of bids and bureaux or black/auction prema. The results broadly corroborate the analysis of the typology of auction designs and policies in the four countries. A summary of the evidence follows.

Auction prices (auction rate, maximum and minimum bids) have been fairly stable in Ghana and Uganda, while in contrast they have been rather volatile in Nigeria and Zambia. For example, the range of auction rates (in terms of domestic currency per US$) was 970-1042 in Uganda and 317-395 in Ghana (in the second auction regime),[13] compared to a range of 3-5 for Nigeria and 5-25 for Zambia (also see Figure 1). Stability of auction prices has improved around a depreciating trend in Ghana as the auction progressed from a retail to a wholesale, auction while volatility increased in Zambia with the change from competitive to Dutch pricing. In Nigeria, however, auction rate volatility has declined, perhaps due to the stabilizing effect of the steady foreign exchange supply. The average max-min bid spread for example declined in Ghana and Nigeria, in contrast to Zambia.

Except for Nigeria, for which the foreign exchange supply has been between US$50-120 million, foreign exchange supplies have been rather volatile[14] ranging from minima of US$ (million) 2.60, 0.33 and 0.85, to maxima of US$ (million) 20.80, 3.48 and 18.48, in Zambia, Uganda and Ghana, respectively. In all of the four countries foreign exchange supply has been almost always less than demand, but the evolution of this ratio over time has been yet another characteristic of the foreign exchange auction setting Ghana and Uganda apart from Nigeria and Zambia. The supply demand ratio in Ghana increased from an average of 0.85 during the retail auction to an average of 0.87 during the wholesale, while the ratio remained quite high at an average rate of 0.90 in Uganda. On the other

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[13] In fact the auction rate was quite volatile in Ghana during the first retail auction, where the maximum set was 314.00 relative to a minimum of only 128.00.

[14] The level non-stationarity of the variables involved, especially the auction prices, limits options for the use of standard devation or coefficient of varation as measures of volatility. For the level varables in Table 2, the volatility measure is the difference between the average minimum and maximum variables.

hand, demand rationing increased in the other two countries as their auctions changed from competitive to Dutch pricing, with supply ratios declining from 0.90 to 0.87 in Nigeria, and from 0.68 to 0.45 in Zambia.

For the case of Zambia, the same story can be told for the winning to total bids ratio, which declined dramatically from an average of 0.65 to 0.42 between the two auction regimes. This is a direct result of the increasing frequency of interventions and bids disqualifications that took place in the Zambian auction. Interventions/disqualifications have also taken place in Nigeria; unlike Zambia, the bid total excludes these disqualifications, so that the successful ratio is high at its average of 0.86 in the competitive auction, and 0.89 in the Dutch. On the other hand, the same ratio remained high at 0.92 on average for Uganda, and was lower at 0.78[15] over the retail auction in Ghana.

The black/auction premium rose from 1.33 to 1.59 between the two auction pricing regimes in Zambia, while it almost remained constant (1.36 to 1.33) between the two similar regimes in the Nigerian auction. On the contrary, the bureaux/auction premium declined dramatically in the Ghanaian auction from an average of 1.31 for the retail regime to only 1.06 for the wholesale. For Uganda the premium rates averaged 1.19 to 1.24 overall.

To conclude, it is important to emphasize that the increasing (or constant) and high premia that prevailed in the Nigerian and Zambian auctions, are the ultimate outcome of the above auction design/policy mistakes in these two countries. The frequent and some times arbitrary interventions/disqualifications have fostered an atmosphere of policy incredibility, lack of transparency and collusive behavior. In addition, the absence of a reserve price policy in the two, countries further compromised stability of auction prices. For a reserve price to be sustainable, however, it has to be consistent with a stable relevant macroeconomic signal, such as the parallel or bureaux rate. Given the rather unstable macroeconomic environment that prevailed in these two countries during the auction experiment, both the bureaux and the parallel market could not constitute efficient secondary markets. These are exactly the problems that the Ghanaian and Ugandan auctions seemed to have avoided, hence their success at achieving exchange rate unification-the key objective of foreign exchange auction in SSA.

3.2 Normality issues

Given the results on the non-stationarity of most of the auction data (see sub-section 3.3 below), the analysis of this sub-section will be based on the rates of changes of the variables in question ($\Delta x_t = \log X_t - \log X_{t-1}$). The departure from normality is another characteristic frequently observed in economic data that has important implications for the analysis of variability and uncertainty. In a recent paper, Pritchett (1991) found that the time series data developing countries real exchange rates tend to be characterized by excess kurtosis (relatively large probabilities of extreme observations) and skewness (tendency of extreme observations in one tail). Pritchett's results suggest that when there are significant higher order moments (skewness and/or kurtosis), the standard

[15] Data on the number of bids are not available for the Ghana wholesale auction.

deviation measure of variability may not be an adequate proxy for uncertainty. As we will see below, the analysis of this sub-section will lend further evidence on the differentiated data characteristics between Ghana and Uganda on one hand and Nigeria and Zambia on the other. Furthermore, given the importance of uncertainty (of foreign exchange supply, for example) for the analysis of bidding behavior in the auction (Aron and Elbadawi, 1994b), the test for normality is crucial for this study.

Separate skewness and kurtosis tests for the rates of changes in auction variables are provided in Table 3, two for skewness (b_3 and s_1) and one for kurtosis (b_4).[16] The first skewness test is the scaled third moment of the distribution about the mean scaled by the standard error, the second is the standard deviation normalized difference of the maximum rate of change minus the absolute value of the minimum rate of change. Values less (larger) than zero indicates left (right) skewness. The excess kurtosis coefficient is given by the ratio of the fourth moment to the square of the second moment minus 3. A value significantly different from zero for this statistic indicates a kurtotic underlying data generating process. Critical values for each of the three tests are derived under a null of a normal distribution. Table 3 also contains a column on standard deviations and two more columns (s_2 and s_3) giving the ratio of the value of the maximum (and the absolute value of the minimum) rate of change relative to the absolute value of the average change.

The results of Table 3 show that the distribution of the auction rate is markedly asymmetric in all of the four countries, with a pronounced tendency towards large depreciation (right skewness) in the cases of Ghana and Uganda, while in the case of Nigeria and Zambia a significant tendency towards appreciation (left skewness) is observed (see also Fig. 2). For the cases of Ghana and Uganda (Nigeria and Zambia), the null hypothesis of a symmetric distribution against the alternative of right (left) skewness could easily be rejected at conventional levels, using both of the two skewness tests. This finding on the differentiated distributional characteristics of the auction rate between Ghana and Uganda on one hand and Nigeria and Zambia on the other, is fairly consistent with the auction designs and outcomes in each of the two groups of countries. In the first two countries, the reserve price effectively ruled out exchange rate appreciation, while on the last two the absence of a reserve price and the frequent disqualification of bidders and the subsequent reduced effective demand for foreign exchange within the auction have fostered a tendency towards exchange rate appreciation. Also in terms of auction outcomes, the tendency towards depreciation in Ghana and Uganda appears consistent with the success of these two countries in closing the auction/bureaux rate premium (unification), while the opposite happened in Nigeria and Zambia.

As with the auction rate, the distributions of the bureaux exchange rate and premia in Ghana and Uganda also exhibits departure from symmetry, albeit with a tendency towards appreciation (left skewness). This behavior is consistent with a frequently, sometimes significantly, declining premium,

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[16] Pritchett noted that in small samples it is difficult to distinguish between skewness and kurtosis. given that a distribution is kurtotic, the critical levels generated for skewness tests assuming a N(0,1) will not be correct and the test will have a tendency to reject the null of zero skewness in this case. Pritchett provides critical values for skewness tests under the null of a more general symmetric, but kurtotic distribution (the student t- distribution). The tests of table 3 abstract from this complication. However, the number of observations available to us is much larger than do Pritchett's.

as the depreciation in the bureaux rates began to fall short of the auction rates depreciation. Furthermore, the bureaux rates seem to be frequently but only incrementally depreciating, while adjustment to previous overshooting (excess lagged depreciations) or movements towards a lower longer-term equilibria have caused substantial and not infrequent appreciations.[17] On the other hand, the two variables (black market) have had a significant but rightly skewed distribution in the case of Nigeria. The tendency towards a rising premium and depreciating black rates could be explained by a combination of two factors: an unstable macroeconomic environment leading to sustained black rate's depreciation, coupled with auction policies that limit depreciation of the auction rate. For the case of Zambia, no significant departures from symmetry could be established for either the premium or the black rate.[18]

In Ghana and Uganda, the distributions of supply variables are characterized by significant right skewness, while demands have been negatively skewed. This implies that in order to ensure convergence of the auction rate towards a unified target rate, the auction foreign exchange supply has been successively adjusted upwards, in the face of declining demand, as the auction rate becomes more depreciated. As with other auction variables, the story is different for the cases of Nigeria and Zambia. The supply and demand variables do not show significant departure from symmetry for Zambia[19], while only the demand variable exhibits significant left skewness in the case of Nigeria. The latter appears consistent with the frequent recourse to the policy of disqualification of bidders noted for Nigeria (section 2).

The final issue on symmetry relates to last two column of Table 3, which gives the ratio of the maximum (and the minimum absolute value) of the rates of change relative to the average of the absolute values of the rates of change. For the auction rate, for example, this indicates how much larger the biggest depreciation (or the absolute value of the biggest appreciation) is than the typical rate of change. The results show rather dramatic orders of magnitude on the departure from symmetry, especially in the cases where deviations from symmetry were found to be significant. For example, the maximum appreciation (s_3) of the auction rates are more than seven times the average absolute rate of change in Zambia, and more than six times the average in Nigeria. On the other hand, the maximum depreciations (s_2) of the auction rates are more than eleven times the average absolute rate of change in Ghana and about nine times the average in Uganda.

The other aspect of departure from normality is provided by excess kurtosis, where the underlying distribution is more peaked and fatter tailed than the normal, implying a larger relative probability of extreme observations in both tails. The evidence on this score is even more overwhelming. Except for the distributions of demand and the premium in Zambia, the null hypothesis of a zero excess kurtosis could be rejected in all other auction variables in all of the four

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[17] Since the bureaux (black) rate is substantally influenced by anticipation of future auction system liberalisation, changes may be apparent in the rate before they actually occur.

[18] This may be explained by the fact that only monthly black market data was available for Zambia.

[19] The reason is that total demand is reported, which includes bids that were later disqualified.

countries. These results provide additional evidence on the prevalence of departure from normality in foreign exchange auction data in Sub-Saharan Africa. However, in this case auction data could not be differentiated between the two groups of countries.

Concerning variability, it has been pointed out by Pritchett that when there is significant departure from normality, the standard deviation may not be the appropriate indicator of uncertainty. For example the rates of changes in the auction rate and the premium in Zambia have almost similar standard deviations at 0.10 and 0.09, respectively. However, they have two very different distributions, the auction rate has a non-symmetric and substantially left skewed kurtotic distribution, while the premium had a kurtotic but symmetric distribution. Another point mentioned by Pritchett is that under departure from normality, there may be several but very contradictory measure of variability, none of which has a clear advantage over the others. This point is validated in our case by comparing the standard deviations of the auction rates in Nigeria and Zambia which are very small at 0.08 and 0.10, respectively, to the ones for Uganda at 1.98 and Ghana at 9.91. This, however, contradicts Figure 1 which shows that exactly the opposite happens.[20]

3.3 Unit Roots, Structural Shifts and Stationarity Issues.

The hypothesis of the unit root (loosely speaking, this refers to a time series with an infinite variance at the limit)[21] in the individual economic time series data has generated considerable attention and acceptability in recent empirical and theoretical economic research. The seminal paper by Nelson and Plosser (1982) which found that most macroeconomic variables have a univariate time series structure with a unit root, and the more recent path-breaking work on cointegration theory[22] (Engle and Granger, 1987) has provided the impetus for a burgeoning research program that has already started to have far-reaching implications for both theory and empirical work in economics. The most important economic implication of the unit root hypothesis is that random shocks have permanent effects on economic variables. In our context this means that the fluctuations that characterize the auction variables are not transitory. Therefore, it is important to conduct careful testing of the unit

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[20] Perhaps this contradiction could be resolved by using the coefficient of variation rather than the standard deviation.

[21] Formally, let $y_t = TD_t + Z_t$ be an economic series composed of a deterministic trend TD_t and a stochastic component. For simplicity assume that Z_t can be described by an autoregressive-moving average process: $A(L)Z_t = B(L)\,e_t$, where $A(L)$ and $B(L)$ are polynomials in the lag operator L and e_t is a sequence of i.i.d. innovations. The noise function Z_t is assumed to have mean zero, the moving average polynomial is also assumed to have roots strictly outside the unit circle. Then Z_t has a unit root if A(L) has one unit root and all other roots strictly outside the unit circle. In this case $(1-L)Z_t = \Delta Z_t$ is a stationary process and $(1-L)y_t = \Delta y_t$ is stationary around a fixed mean. If on the other hand A(L) has all its roots outside the unit circle, then Z_t is a stationary process and y_t is stationary around a trend.

[22] The idea of cointegration basically states that even though individual series may have a unit root, there may exist various linear combinations of variables which are stationary. Stated more formally in the context of the definition of footnote 1, let the n-vector y_t be composed of $(y_{1t}, \ldots y_{nt})$, where y_{it} is defined in footnote 1 above. Then y_t is said to be cointegrated if there exists at least one n-element vector β such that $\beta' y_t$ is trend stationary. This is a milder definition of cointegration (Campbell and Perron, 1991), which is more suited to analysis of economic date since it permits the inclusion of deterministic components (such as trends and structural break dummies) in the cointegration model along with other non-stationary stochastic variables.

root hypothesis for each of the auction variables of interest. These tests are presented in Aron and Elbadawi (1994): in all four countries, the data series for each of the three exchange rate variables (the auction, bureaux rates and the premium) was found to have a unit root non-stationary process.

Noting that the distinction between a random walk (unit root) and a trend-stationary series is extreme, Cochrane (1988) argues that there are many cases where a stationary but a slow trend-reverting series could be confounded with unit root series. To address this problem with unit root tests, he proposed a variance ratio test that basically asks the following question: How large is the variance of shocks to the random walk or permanent component of the series compared with the variance of the growth rates of the series? Or, equivalently, How big is the random walk in the series? The ratio is given by $\frac{1}{k}\cdot\frac{\hat{V}ar(X_t-X_{t-k})}{\hat{V}ar(X_t-X_{t-1})}$ [23]. For a stationary series the ratio will eventually converge to zero as k goes to infinity, the speed of this convergence reflects the extent to which the stationary time series structure is closer to either of the two polar cases: the stationary (zero root) or the random walk (unit root). On the other hand a unit root series will have a ratio that settle down to the share of the variance of the shock to the random walk component in the total variance (> 0). Figure 3 shows the plots of the Cochrane ratio for the auction equilibrium exchange rates against k for each of the four auctions. The auction rate is much closer to the unit root case in both the Ghana and Uganda, where the shares of the random walk in total variance settle down to approximately 77 percent in Ghana and 96 percent in Uganda.[24] Particularly in the case of Ghana, the ratios have in fact diverged for a prolonged time before starting to converge at $k = 62$. On the other hand, random walk components account for about 54 percent of total variance of the auction rate in Zambia, and only about 6 percent of total variance in Nigeria. Furthermore, convergence of the variance ratios have started rather rapidly (at $k = 2$) in both countries. This finding is again fairly consistent with the stochastic reserve price[25] that has had a significant effect on the auction rates in Ghana and Uganda, as opposed to the frequent and direct policy interventions that characterized the Nigerian and Zambian auctions. Therefore it is obvious that the auction rate is characterized by high persistence (random walk component), which agrees with the unit root tests in Aron and Elbadawi (1994). But Figure 3 also shows the presence of substantial temporary components in the innovation variances of these series, especially in the cases of Nigeria and Zambia. This is also in general agreement with the prevalence of deterministic trends and regime shifts in auction rates and auction data (Figure 1).

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[23] The large sample standard error for the ratio is given by $\sqrt{\frac{4K}{3T}\cdot\frac{\hat{V}ar(X_t-X_{t-k})}{\hat{V}ar(X_t-X_{t-1})}}$, where T is the number of observations.

[24] The choice of the terminal k is rather arbitrary, but following Cochrane we chose the maximum k to be the range of one fourth to a third of the total number of observations.

[25] The reserve prices closely follows the evolution of the bureaux or parallel rates in Ghana and Uganda which are shown to be I(1) series (Table 4).

4. A MACRO-ECONOMIC OVERVIEW OF THE SSA FOREIGN EXCHANGE AUCTIONS.

It is not our intention to examine in any detail the macro-determinants of the auction rate in this paper.[26] However, we present in this section a brief overview of the macro-economic environment in the four countries, with the objective of explaining the observed differentiated outcomes of foreign exchange auctions in the four countries. The macro-economic story is provided by Figures 1 and 4, focusing on exchange rates, premia and monetary emission. The broad conclusion that can be derived from these graphs points to the importance of a stable macro-economic environment for the achievement of a steady and sustainable progress towards a unified exchange rate.

Ghana and Uganda seem to be largely on target regarding the above objective. Figures 1 b and 1 c show a steadily depreciating and stable auction rate over time, while a significantly declining bureaux/auction premium is observed. Thus, these countries have been able to achieve a reasonable degree of unification and exchange rate stability. At the heart of this outcome, as shown by Figures 4 b and 4 c, is a sustained decline in monetary growth. This is reflected in a deceleration in inflation, and a stable bureaux rate in both Uganda and Ghana, where in Ghana this followed an episode of deep depreciation towards what appears to be an equilibrium path. The figures also show a clear lead/lag effect going from monetary emission to inflation and bureaux rate depreciation. This indicates that not only has macro-policy been consistent, but also that it has been credible in these two countries.

In contrast, in Nigeria and Zambia, Figures 1 a and 1 d also show a depreciating auction rate, but with far greater volatility. More importantly, unlike the other two countries, the black/auction premium was steadily rising. This counters both the objectives of stability and exchange rate unification. This could be a direct outcome of unsustainable macro-economic policy and the collapse of policy credibility. This is corroborated by Figures 4 a and 4 d. Very volatile and significantly rising rates of growth of money supply over time are observed in both countries. This is reflected in high inflation and black/auction premia variability, with extended episodes of sharply rising premia.

The relevance of macroeconomic policy in differentiating between auction outcomes in Ghana and Uganda on one hand and Nigeria and Zambia on the other, is fairly consistent and closely linked with the evidence on the microeconomic determinants of the auction rate (sections 2 and 3). For example, the reserve price policy in Ghana and Uganda has been credited with fostering auction rate stability. For these two countries to manage a successful reserve price policy, a sustainable secondary market signal is necessary. This was provided by a fairly stable bureaux rate, made possible by a credible macro-environment. These results are also corroborated by the more formal analysis of Aron and Elbadawi (1994).

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[26] However, in a subsequent paper we plan to analyse macro-economic issues in the context of auction markets and exchange rate unification in SSA.

5. CONCLUSIONS AND POLICY LESSONS.

The experience of foreign exchange auctions in SSA has been one of rich and diversified design features, policy interventions and outcomes. This paper has compared and contrasted auction designs and outcomes across four SSA countries and produced a typology of SSA foreign exchange auctions. Two distinct sets of countries have been identified in terms of design features, auction policies and outcomes. Ghana and Uganda represent a set where auctions have been judged to be largely on target in terms of the three policy objectives of exchange rate unification, stabilisation of the exchange rate and an efficient allocation of foreign exchange. On the other hand, the auctions in Zambia and Nigeria were subject to frequent policy interventions, with the consequence of unsustainable auctions, inefficient allocation through ad hoc disqualifications (at least in Zambia), limited unification, and a rather volatile exchange rate. The conclusions of this analysis are broadly corroborated by a statistical analysis of the micro-auction data for all four countries. A summary of the main stylised facts and their possible explanations follow.

First, auction prices have been fairly stable in Ghana and Uganda, while in contrast they have been rather volatile in Zambia and Nigeria. Stability of prices improved around a depreciating trend in Ghana as the auction progressed from a retail to a wholesale auction. In Zambia, price stability decreased from the competitive to the Dutch auction; while in Nigeria the reverse was true, perhaps due to the effect of stable supply. Empirical evidence on the departure from normality of the differenced auction rate is provided by skewness tests on auction data. All four countries show markedly asymmetric auction rates; Nigeria and Zambia have a significant tendency toward left skewness (appreciation), while Ghana and Uganda display a pronounced tendency towards depreciation (right skewness). For all countries, appreciation or depreciation tends to show a very high order of magnitude for the absolute value of highest appreciation or depreciation relative to the average rate of change. Thus, departure from symmetry is not trivial when it it is statistically significant. Further, excess kurtosis is significant in all data in all auctions, which implies a high probability of extreme observations in both tails of the distribution of auction data. Kurtosis measures do not offer any criteria for differentiating between the countries, but reinforce the point that the standard deviation is not a useful measure of exchange rate variability given these departures from normality.

An explanation for increased stability in our first set of countries is that Ghana and Uganda used (unannounced) reserve prices, while Zambia and Nigeria did not. This "crawling peg" type system prevented appreciation in the presence of disqualifications. At the same time the depreciation path of the exchange rate was smoothed as bidders learnt the reserve price rule, which is perhaps evidenced by the dramatic fall-off of the bid-spread over time in Ghana and Uganda. Furthermore, in Ghana and Uganda, not only were the parallel markets legal (bureaux markets), but the macro-policies followed were relatively consistent: these two facts allowed the bureaux rate to constitute a credible and efficient secondary market signal for the reserve price rule. It would be interesting to test the observed differences in exchange rate depreciation across regimes, such as Dutch and competitive pricing, or retail and wholesale auctions.

Second, foreign exchange supply was found to be rather volatile in all countries save Nigeria, where a pre-announced supply rule was adhered to. Differenced foreign exchange supply in Ghana and Uganda is characterised by significant right skewness, suggesting that supply was successively adjusted upwards to allow convergence of the auction rate to a unified target rate, as the auctions were liberalised. The opposite holds for Zambia and Nigeria. It would be useful to ascertain whether this volatility influenced the path of the exchange rate. The implication of the observed non-normality of the supply variable is important for its use as a proxy for uncertainty. The preceding discussion suggests that where supply volatility is high, which may raise uncertainty in thin markets, there may be considerable virtue in the use of a reserve price.

Third, foreign exchange rationing reflected in the total to satisfied demand ratio was at a high level in the Zambian and Nigerian auctions, while it remained constant and low in Ghana and Uganda. Similarly, the winning to total bids ratio declined dramatically in Zambia, while remaining at a very high average level in Uganda (data are missing for the other two countries). In Ghana and Uganda the auction systems were gradually widened, increasing competition, fostering confidence in the system and importantly deepening financial markets by allowing institution-building over time. This gradualism allowed the transition to a less concentrated interbank market, less liable to collusive practices. By contrast, auctions in Zambia and Nigeria saw restrictions tightened over time in an attempt to suppress depreciation. It would be interesting to assess the impact of increased competition through an enlarged set of bidders and allowable imports, on the level and stability of the exchange rate.

Fourth, the parallel market premium was high for Zambia and Nigeria, whilst the bureaux premium experienced a sustained and sharp decline for Ghana and Uganda over time. In Ghana and Uganda the bureaux rates and premia exhibit departures from symmetry, with a tendency towards appreciation (left skewness). This is consistent with a steady and incremental depreciation, and infrequent but sometimes significant appreciation as a response to past overshooting, or adjustment towards a longer-term equilibrium. On the other hand, Nigeria displays right skewness; while in Zambia, where data only of lower frequency was available for the black market (monthly) there is no evidence of skewness.

The tendency towards a rising premium and depreciating black rates can be explained by a combination of two factors: an unstable macro-economic environment, coupled with micro-auction policies that attempted to curtail depreciation. The brief macro-analysis in this paper suggests that the unsustainable macro-economic policies in Nigeria and Zambia had a major impact on credibility and the size of the parallel premia. The key macro-policy lesson is that these two countries did not make the commitment to switch the nominal anchor from the exchange rate to the money supply, despite their claimed policy objective of exchange rate unification.

On the micro-side, the frequent and sometimes arbitrary interventions/disqualifications fostered an atmosphere of policy incredibility, lack of transparency and collusive behavior. A major lesson from the Zambian and Nigerian auctions is that if there isn't transparency in the auction, it is probably pointless holding one. Ghana achieved transparency in a very effective manner: the management committee did not only consist of Central Bank personnel, but included representatives from the

commercial banking sector and private sector, and was chaired by a commercial banker. There was fairly broad consultation on changes in the Central Bank's regulations for the auction, and rules and amendments to rules were published. Uganda similarly operated with a high degree of transparency, with public opening of the bids.

Fifth, one final set of empirical analyses reveals the presence of considerable non-stationarity and regime shifts for most of the auction data from the four countries. This is unsurprising in view of the above stylised facts which emphasise rule changes, the non-normality of auction data and the importance of anticipations of policy changes. The non-parametric variance ratio test (Cochrane, 1988) showed that the share of the random walk component in the total variance of the rate of change in the auction rate, while large for all of the countries, is noticeably smaller for Nigeria and to some extent, Zambia. The rate of convergence also started rather more rapidly in these two countries. This finding is again consistent with the use of a stochastic reserve price in Ghana and Uganda (i.e. based on the non-stationary bureaux series), as opposed to the frequent and direct policy interventions that characterised the Zambian and Nigerian auctions. These results on non-stationarity have profound implications for the way in which auction data are analysed: random shocks have permanent effects on economic variables, and consistent testing of the behavioural propositions of auction theory requires modelling to account for these data characteristics.

In our companion paper (Aron and Elbadawi, 1994b) we build on the results of this paper, and estimate dynamic models influenced by auction theory for the determination of the auction rate in these four countries, using weekly micro-auction data. Our modelling methodology takes account of the non-stationarity of the auction data as well as regime changes and policy interventions. As motivated above, we use these models to test the impact on the level of the auction rate of increased competition amongst bidders, the effect of uncertainty (proxied by a volatile supply of foreign exchange to the auction), and different pricing mechanisms (Dutch and marginal pricing).

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TABLE 1: Some design characteristics of SSA foreign exchange auctions.

	ZAMBIA	UGANDA	NIGERIA	GHANA
duration[1]	11 Oct.'85 to 24 Jan.'87	31 Jan.'92 to 7 May '93	26 Sep.'86 to 24 Nov.'88	19 Sept.'86 to 5 March'92
number	68	67	67	270
frequency	weekly	weekly	weekly(1-24) fortnight(25-67)	weekly
pricing[2]	competitive(1-42) Dutch(43-68)	Dutch(1-67)	competitive(1-24) Dutch(25-67)	competitive(1) Dutch(2-270)
sale	retail	"wholesale"	"wholesale"	retail (1-174) wholesale(175-)
bidders[3]	importers	banks tied to importers (1-) + bureaux (10-)	banks with resale (1-30) banks tied to importers (30-67)	importers (1-174) + banks (161-174) banks (175-270)
submission	individual bids by importer	composite bids by bank (aggregating importer bids by price)	individual bids by bank	individual bids by importer (1-174) by bank (175-270)
entry restrictions	yes: increased during auction	initial: removed during auction	yes: increased during auction	initial: gradually removed totally
allocative caps[4]	no	yes	yes	no
monitoring	stringent	stringent	variable(1-59) stringent(60-67)	stringent
auctioned supply	foreign aid, copper receipts	aid	aid, oil receipts	aid,cocoa receipts, non-trad. exports
published bids[5]	yes: individual bids P,Q,U, (37-68)	yes: composite bids by bank P,Q	no	no
reserve price	no	yes: not announced	no	yes: not announced
pre-announced supply	yes: a ceiling, not adhered to, except (55-68)	yes: just prior to opening bids	yes: just prior to opening bids	no
transparency[6]	poor	high	poor	high
secondary market	illegal, black	bureaux, legal	illegal black	illegal black(1-74) bureaux,legal(74-)

SOURCE: Central Bank guidelines; interviews, World Bank and I.M.F..

1. Zambia had 6 further two-tier auctions March-April, 1987 (not analysed due to incomplete data), and in April, 1987 reverted to a fixed rate regime. Uganda's auction was ongoing at the time of analysing these data; but was replaced by an interbank market in late 1993. Nigeria established an interbank market during Jan.'89-Jan.'91. Daily auctions were held, but were not competitive: banks were guaranteed foreign exchange allocation based on institutional size, regardless of their bids. Ghana ended the auction and established an interbank market in March, 1992.
2. The definitions of pricing are as follows: (i) competitive pricing: bidders pay the marginal rate (on ordering bids by decreasing price) which exhausts the available foreign exchange, regardless of their bids; (ii) Dutch pricing: bidders pay the price they bid.
3. "Bidders" refers to those who submit their bids to the Central Bank. In the retail auctions importers submitted their own bids (which were channelled through non-participating banks). In Nigeria's wholesale auction, at first auctioned foreign exchange could be freely resold in the interbank market; thereafter banks were required to have non-bank customers to cover their bids. Nevertheless it was the banks' bids alone that determined the clearing prices in Nigeria.
4. The ceilings on maximum shares of offered supply for bidding banks were frequently altered in Nigeria.
5. P, Q, U: price, quantity requested, use of foreign exchange.
6. The reasons for this assignment of auction transparency are discussed in the text.

TABLE 2: *Average weekly size of auction variables by auction type.*[1]

ZAMBIA	COMPETITIVE (1-42)			DUTCH AUCTION (43-68)			OVERALL (1-68)		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
prices:									
auction rate	6.56	5.01	8.07	10.11	5.01	15.25	7.92	5.01	15.25
maximum bid	7.97	6.50	15.00	11.54	6.85	18.00	9.34	6.50	18.00
minimum bid	5.00	2.44	7.10	5.47	4.01	6.00	5.18	2.44	7.10
spreads:									
max-min spread	2.97	0.55	12.25	6.07	1.85	12.00	4.16	0.55	12.25
max-oer spread	1.41	-0.01	9.99	1.43	0.28	5.90	1.42	-0.01	9.99
min-oer spread	1.56	0.03	4.56	4.64	0.00	9.25	2.74	0.00	9.25
quantities:									
supply ($ mill)[2]	5.67	3.50	8.80	6.01	2.80	20.80	5.80	2.60	20.80
demand ($ mill)	9.19	3.50	21.70	14.25	5.80	24.00	11.12	3.50	24.00
supply/demand	0.68	0.28	1.00	0.45	0.12	0.91	0.59	0.12	1.00
number of bids:									
total no. bids	289	101	600	482	192	769	355	101	769
winning/total bids	0.65	0.21	0.99	0.42	0.17	0.88	0.56	0.17	0.99
black market:									
black/auc premium[3]	1.33	1.16	1.80	1.58	1.27	1.93	1.43	1.16	1.93

UGANDA	OVERALL AUCTION (1-62)		
	Mean	Minimum	Maximum
prices:			
auction rate	1022.21	970.00	1042.00
maximum bid	1043.73	1010.00	1200.00
minimum bid	1019.45	900.00	1042.00
spreads:			
max-min spread	24.27	1.00	200.00
max-oer spread	21.52	1.00	176.00
min-oer spread	2.76	0.00	80.00
quantities:			
supply ($ mill)	1.80	0.33	3.48
demand ($ mill)	2.02	0.46	4.00
supply/demand	0.90	0.17	1.00
number of bids:			
total no. bids	14.32	7.00	30.00
winning/total bids	0.92	0.36	1.00
bureaux market:			
bureaux rate (sell. T.Cheque)	1216	1192	1264
bureaux bid-ask spread	0.96	0.90	0.97
bur/auc premium (T.Cheque)	1.19	1.16	1.30
bur/auc premium (cash)	1.24	1.20	1.33

TABLE 2: (Contd.)

GHANA	RETAIL (1-175)			WHOLESALE (176-270)			OVERALL (1-270)		
	Mean	minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
prices:									
auction rate	215.89	128.00	314.00	358.25	317.00	395.00	266.35	128.00	395.00
maximum bid	223.15	152.00	316.00	362.03	318.00	420.00	272.37	152.00	420.00
minimum bid	213.55	90.00	314.00	357.63	317.00	395.00	264.62	90.00	395.00
spreads:									
max-min spread	9.60	2.00	68.00	4.40	0.00	30.00	7.75	0.00	68.00
max-oer spread	7.26	1.00	51.00	3.78	0.00	27.00	6.02	0.00	51.00
min-oer spread	2.34	0.00	45.00						
quantities:									
supply ($ mill)	5.46	1.06	12.38	7.37	0.85	18.48	6.18	0.85	18.48
demand ($ mill)	6.78	1.35	17.91	8.62	0.85	19.28	7.47	0.85	19.28
supply/demand	0.85	0.18	1.00	0.87	0.15	1.00	0.86	0.15	1.11
number of bids:									
total no. bids	141	32	458	na	na	na	na	na	na
winning/total bids	0.78	0.15	1.00	na	na	na	na	na	na
bureaux market:[3]									
bur. bid-ask spread	0.95	0.90	0.98	0.97	0.94	0.99	0.98	0.90	0.99
bureaux rate (sell)	363.21	317.00	377.50	378.78	347.50	440.00	372.44	317.00	440.00
bur/auc. premium	1.31	1.14	1.51	1.06	1.03	1.14	1.18	1.03	1.51

NIGERIA	COMPETITIVE (1-42)			DUTCH AUCTION (43-68)			OVERALL (1-68)		
	Mean	minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
prices:									
auction rate	3.71	3.00	4.90	4.25	3.50	5.28	4.06	3.00	5.28
maximum bid	4.33	3.50	5.60	4.41	4.02	5.30	4.38	3.50	5.60
minimum bid	3.38	2.50	3.90	4.21	3.50	5.28	3.91	2.50	5.28
spreads:									
max-min spread	0.95	0.30	2.64	0.21	0.00	0.90	0.47	0.00	2.64
max-oer spread	0.62	0.25	1.85	0.16	0.01	0.90	0.33	0.01	1.85
min-oer spread	0.33	0.00	1.90	0.04	0.00	0.38	0.15	0.00	1.90
quantities:									
supply ($ mill)	63.17	50.00	86.00	106.83	70.00	120.00	91.06	50.00	120.00
demand ($ mill)	71.77	38.39	100.10	123.80	64.39	150.00	105.16	38.39	150.00
supply/demand	0.90	0.50	1.30	0.87	0.87	1.10	0.88	0.50	1.30
number of bids:									
total no. bids	38	27	44	48	30	53	45	27	53
winning/total bids	0.86	0.34	1.00	0.89	0.88	1.00	0.88	0.34	1.00
bureaux market:									
bureaux rate	5.00	4.70	5.70	5.70	4.20	8.60	5.45	4.20	8.60
bur/auc premium	1.36	1.10	1.67	1.33	1.04	1.75	1.34	1.04	1.75

SOURCE: Authors' calculations.

1. The auction variables are mostly non-stationary (Aron and Elbadawi, 1994), so that conventional measures of variability (standard deviation) are not defined.
2. Although all Zambian parastatals were included in the auction from auction 20, the largest of them continued to receive substantial foreign exchange with non-competitive bids at the marginal rate. A corrected value is thus used for supply in the Zambian regressions.
3. Black market data for Zambia are monthly, from Picks Currency Yearbook. Weekly Nigerian black market data are compiled from the World Bank resident mission estimates and Picks. Foreign exchange bureaux began functioning in Ghana from April, 1988. Regressions use some black market data.

TABLE 3: Measures of normality for first-differenced auction variables.

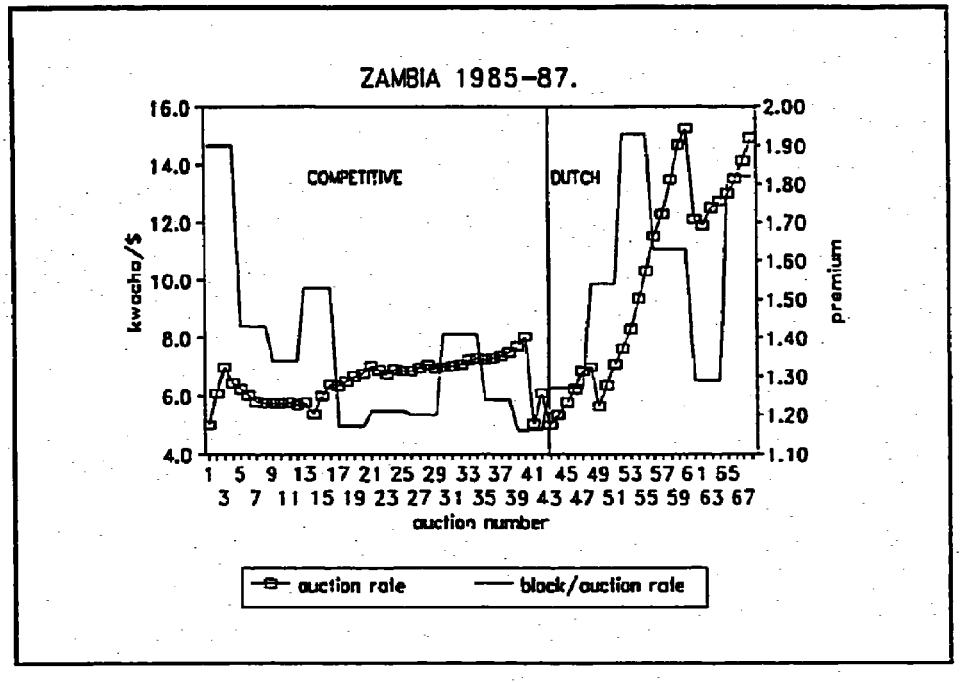
	N	b_3 Skewness	b_4 Kurtosis	σ Std. Dev.	S_1 $\frac{X_{max}-\lvert X_{min}\rvert}{\sigma}$	S_2 $\frac{X_{max}}{(\Sigma\lvert X\rvert/n)}$	S_3 $\frac{\lvert X_{min}\rvert}{(\Sigma\lvert X\rvert/n)}$
ZAMBIA							
$\Delta\log(oer)$	67	-2.38	10.22	0.10	-2.87	3.25	7.80
$\Delta\log(Qs)$	67	-0.16	1.44	0.41	-0.76	3.64	4.74
$\Delta\log(Qs_c)$	67	-0.61	2.37	0.45	-1.56	3.18	5.35
$\Delta\log(Qd)$	67	0.47	0.32	0.27	0.84	3.72	2.66
$\Delta\log(Qs/Qd)$	67	-0.78	1.71	0.42	-1.30	3.00	4.78
$\Delta\log(prem_t)$	67	0.22	-0.78	0.04	0.43	2.61	2.11
$\Delta\log(prem)$	67	0.12	6.16	0.09	0.68	9.59	7.92
UGANDA							
$\Delta\log(oer)$	66	3.31	12.45	1.98	5.16	9.09	0.00
$\Delta\log(Qs)$	66	0.42	2.86	0.70	0.24	4.79	4.45
$\Delta\log(Qd)$	66	-0.06	2.01	0.59	0.31	4.38	3.96
$\Delta\log(Qs/Qd)$	66	0.68	9.73	0.36	1.03	8.76	6.81
$\Delta\log(ber_{TC})$	61	-1.95	6.34	3.58D-3	-1.88	3.48	6.66
$\Delta\log(prem_{TC})$	61	-1.46	2.69	4.29	-1.91	2.31	5.26
$\Delta\log(prem_c)$	61	-0.80	2.74	4.36	-2.24	2.58	5.53
GHANA							
$\Delta\log(oer)$	269	2.64	16.30	9.91	2.46	11.61	7.20
$\Delta\log(Qs)$	269	-0.09	4.78	0.41	-0.86	6.47	7.65
$\Delta\log(Qd)$	269	-0.93	5.16	0.41	-2.74	4.44	8.18
$\Delta\log(Qs/Qd)$	269	0.80	5.52	0.29	2.25	9.81	5.87
$\Delta\log(ber)$	196	-1.32	14.77	0.01	-2.08	8.06	12.12
$\Delta\log(prem)$	196	-0.85	9.74	0.02	-2.23	5.99	9.72
NIGERIA							
$\Delta\log(oer)$	66	-1.33	6.71	0.06	-0.89	5.37	6.84
$\Delta\log(Qs)$	66	0.38	4.78	0.14	0.45	7.84	6.59
$\Delta\log(Qd)$	66	-1.25	5.47	0.19	-2.08	3.79	7.29
$\Delta\log(Qs/Qd)$	66	1.95	6.86	0.16	2.14	8.06	4.10
$\Delta\log(ber)$	66	-0.01	2.55	0.04	0.20	5.08	4.77
$\Delta\log(prem)$	66	1.30	6.88	0.09	1.69	7.35	4.58

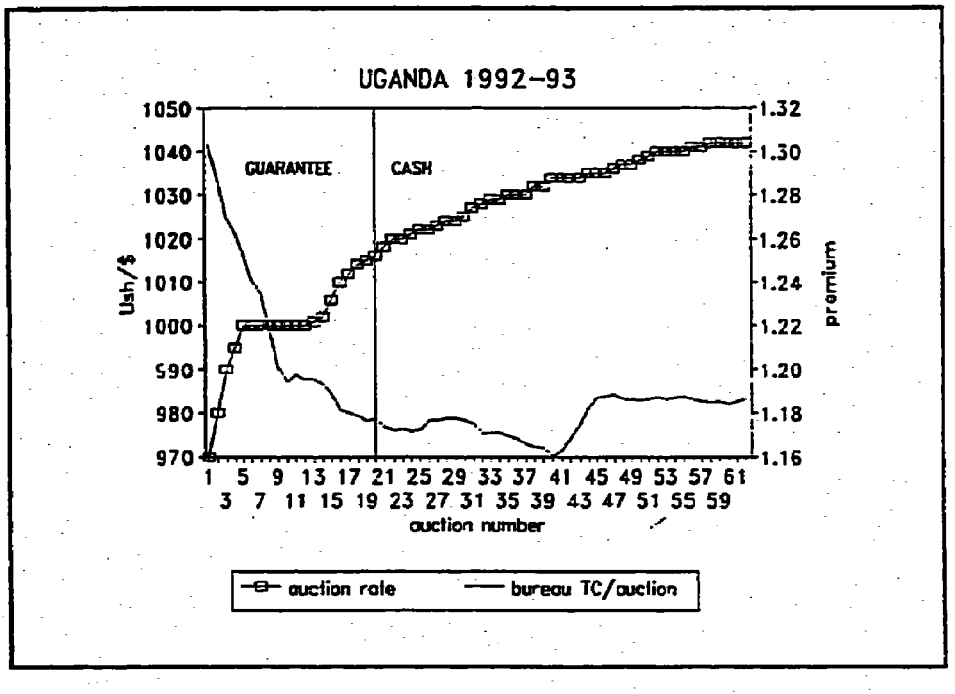
SOURCE: Authors' calculations.

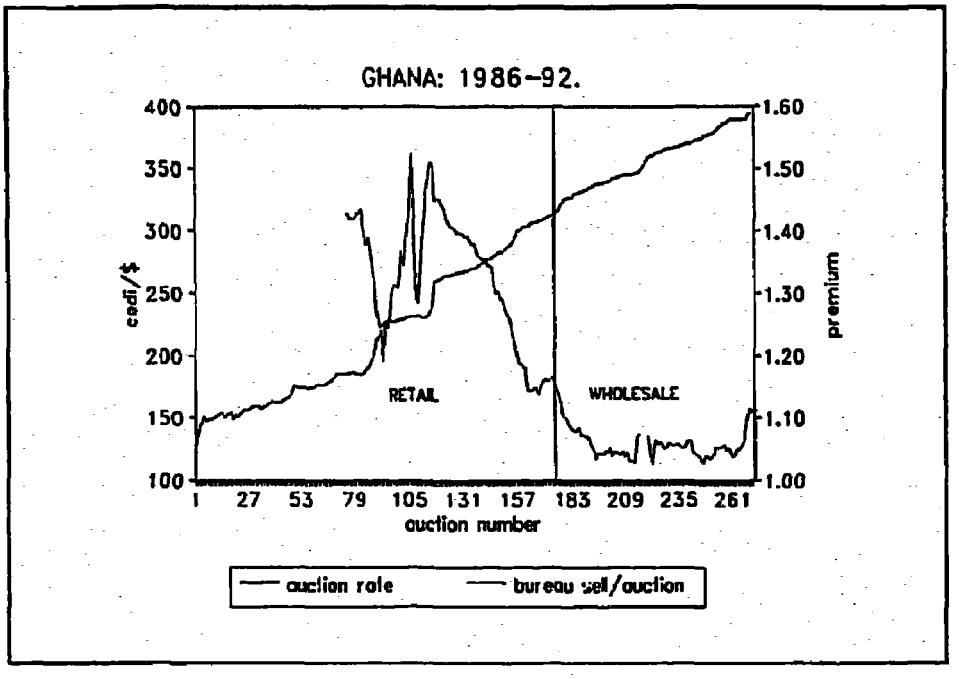
NOTES:

1. The following abbreviations are used: oer (auction exchange rate, local currency/$); Qs ($ supplied); Qs_c ($ supplied, less non-competitive parastatal bids at the marginal rate); Qd ($ demanded); prem (parallel (or bureaux)/auction rate); $prem_t$ (interpolated monthly premium); ber_{TC} (bureau sell rate for traveller's cheques); ber_C (bureau sell rate for cash).

FIGURE 1 a,b,c,d: The equilibrium auction price and parallel market premium.






GHANA: 1986-92.
cedi/$
premium
RETAIL
WHOLESALE
auction number
auction rate
bureau sell/auction

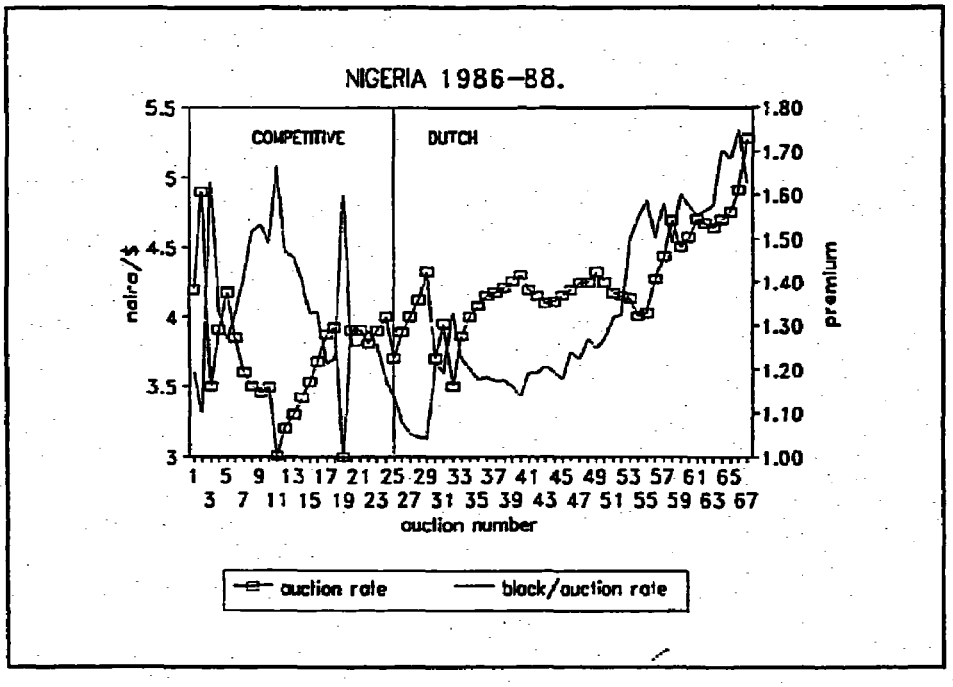
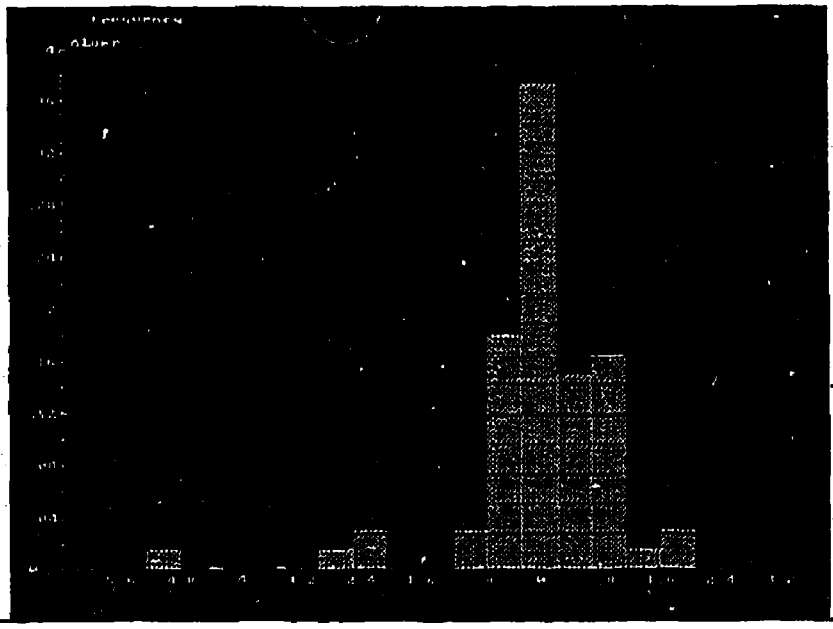
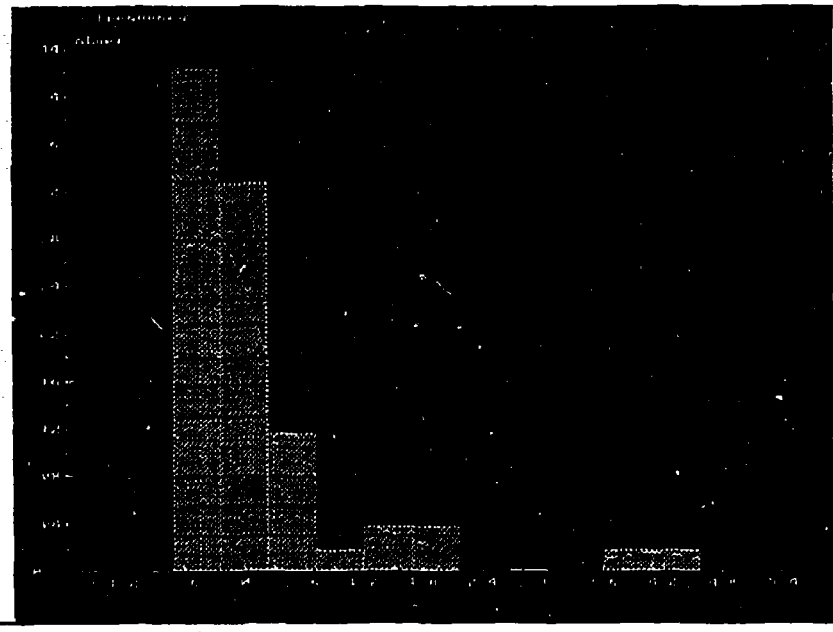

NIGERIA 1986-88.
naira/$
premium
COMPETITIVE
DUTCH
auction number
auction rate
black/auction rate

FIGURE 2 a,b,c,d: Skewed and kurtotic distributions of auction exchange rate changes.

ZAMBIA



UGANDA



GHANA

NIGERIA

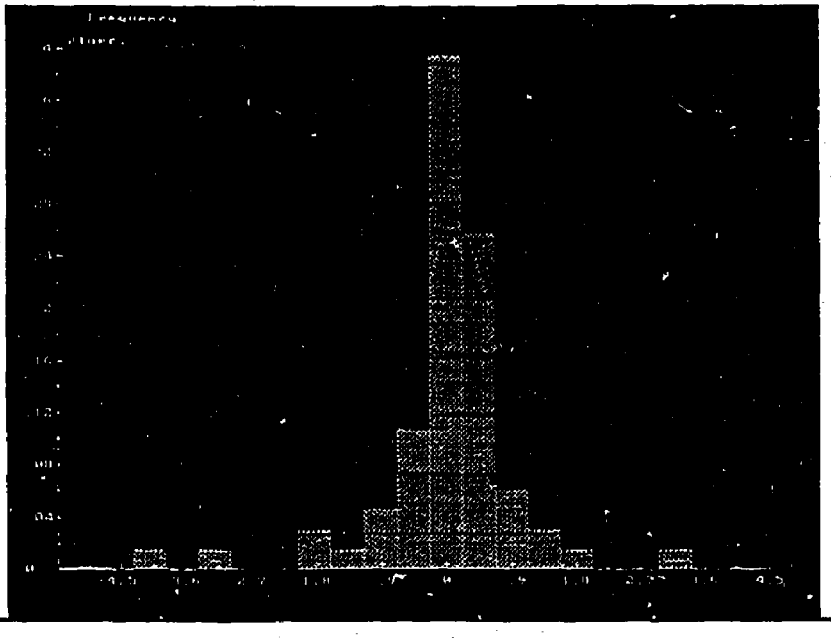
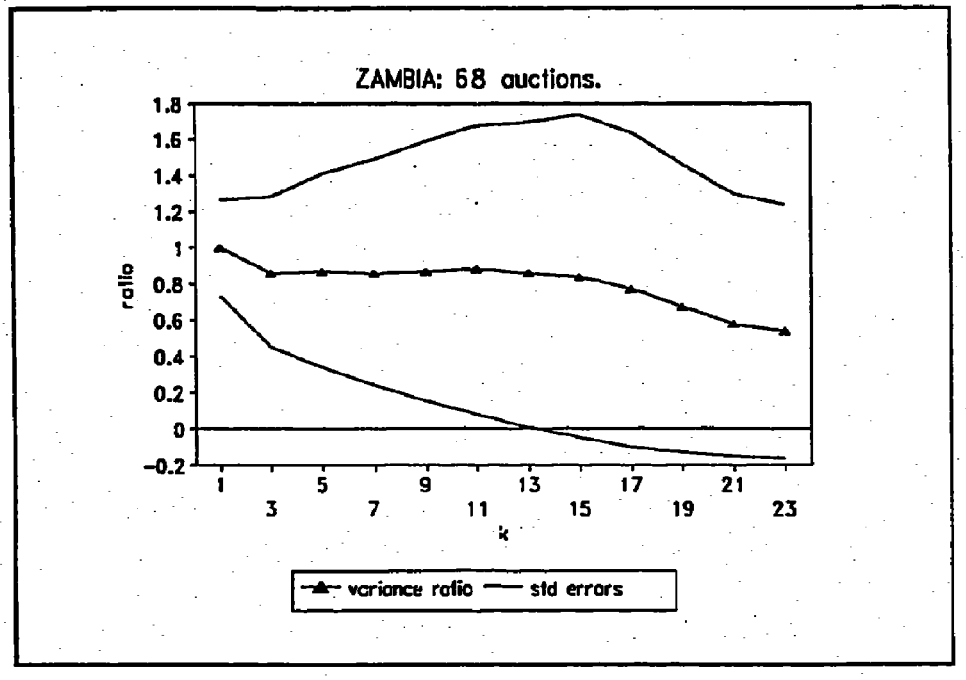
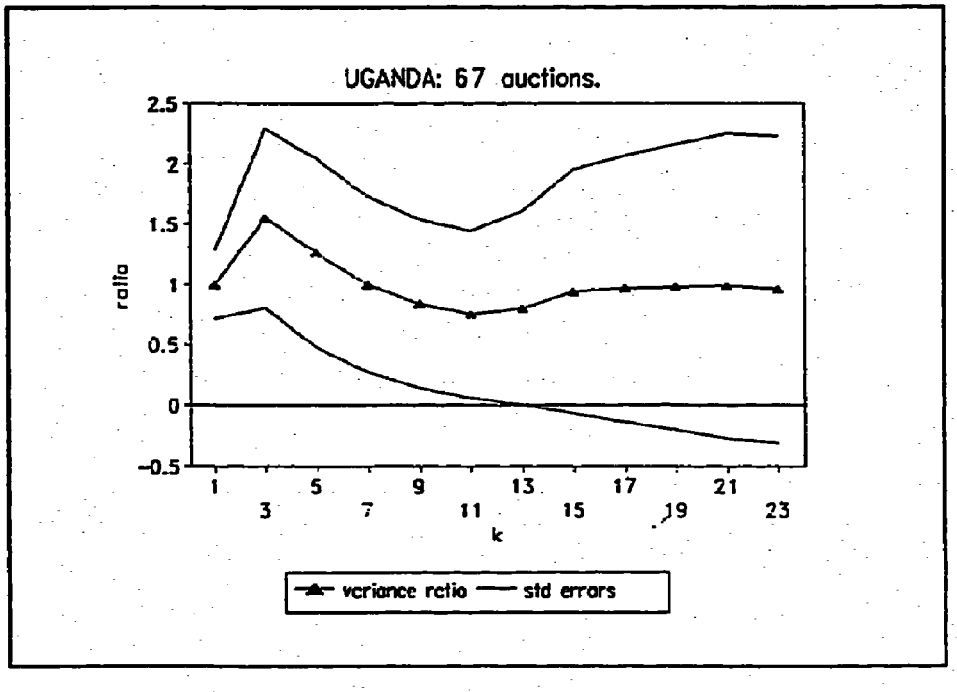
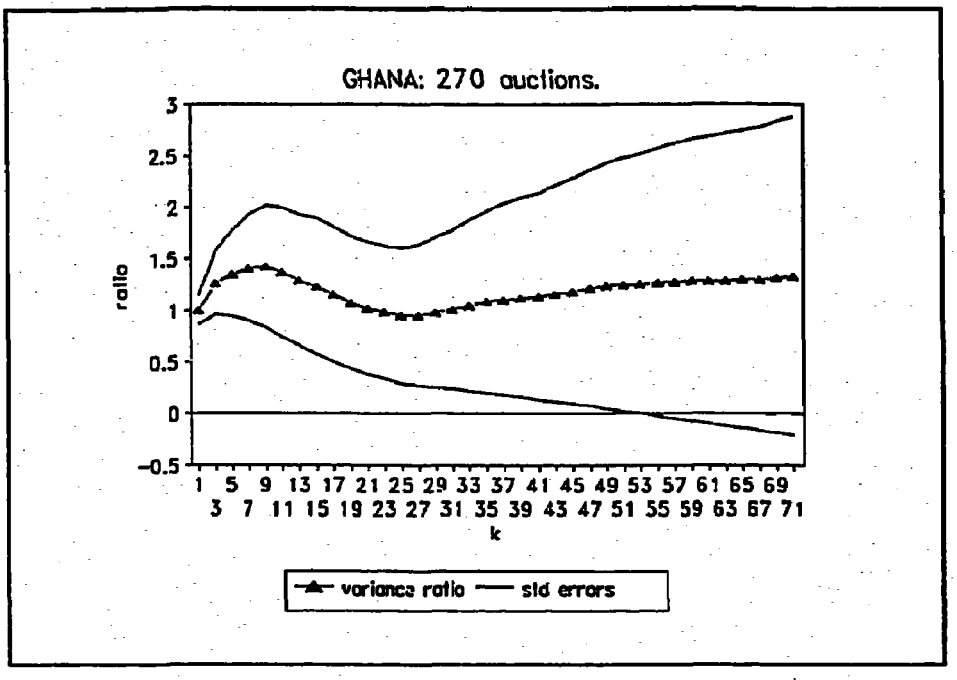


FIGURE 3 a,b,c,d: Cochrane persistence test for the auction exchange rates.






GHANA: 270 auctions.
ratio
k
variance ratio
std errors

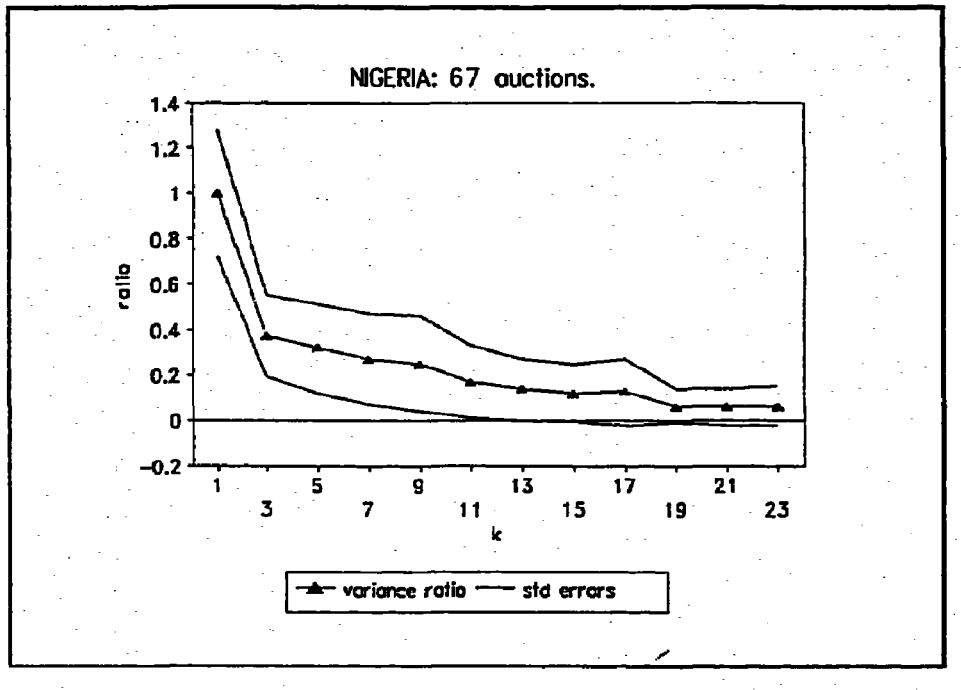
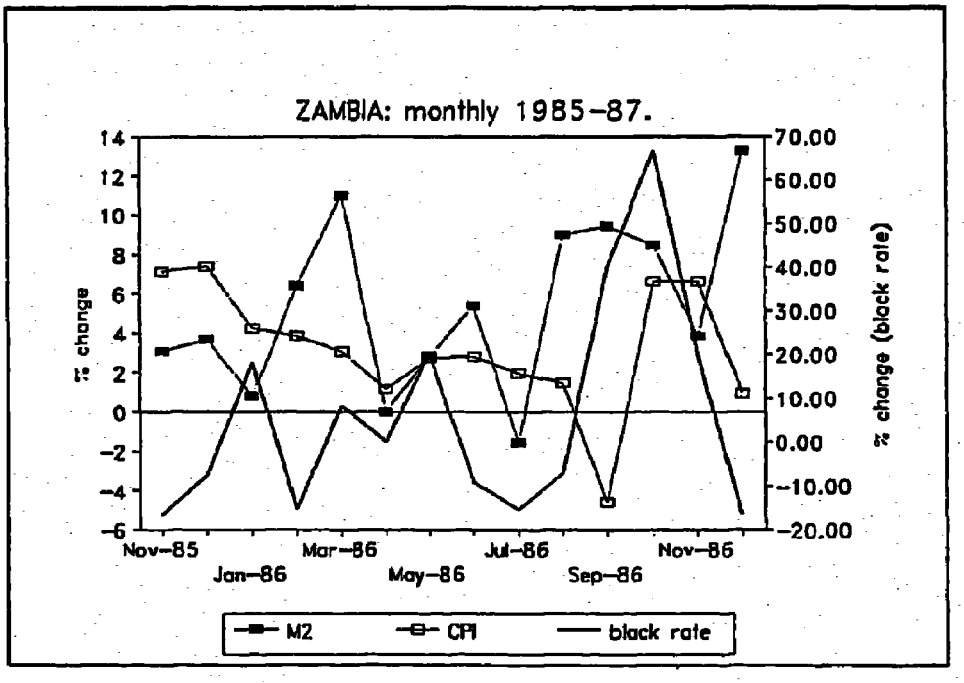
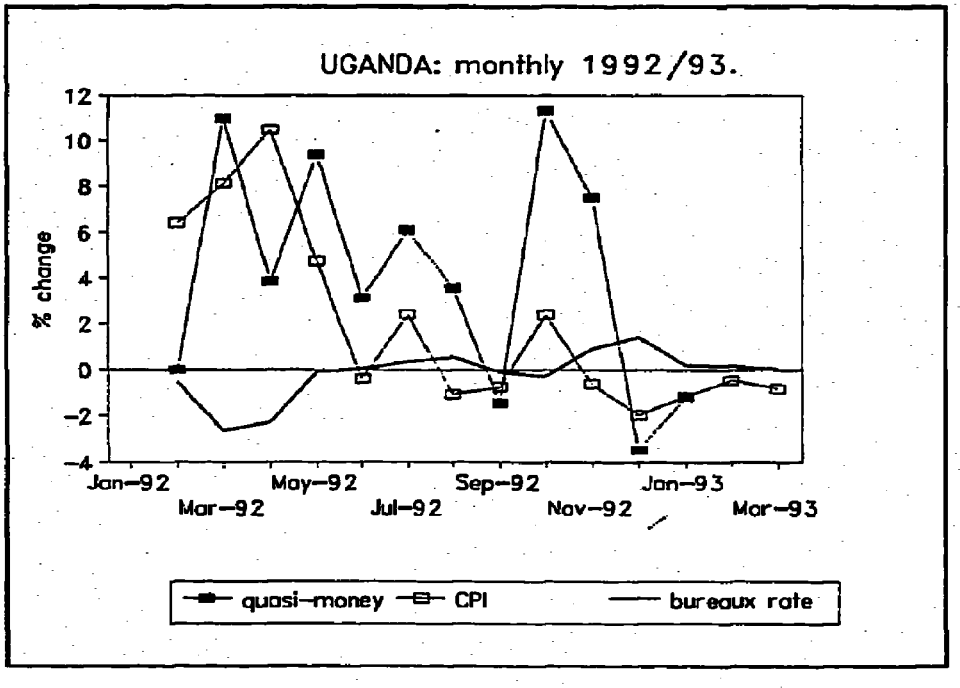
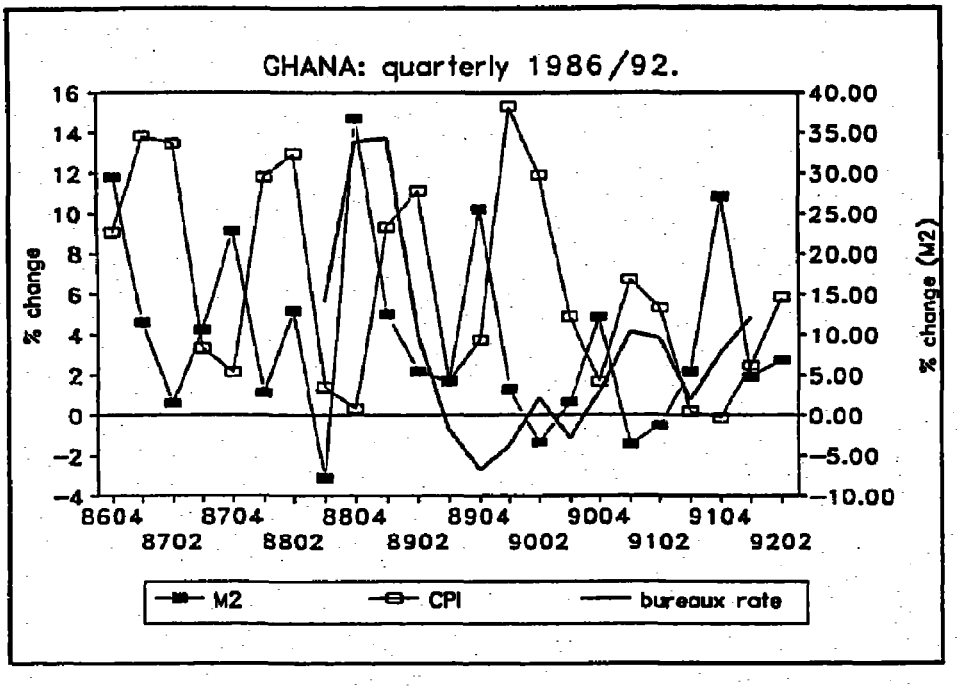
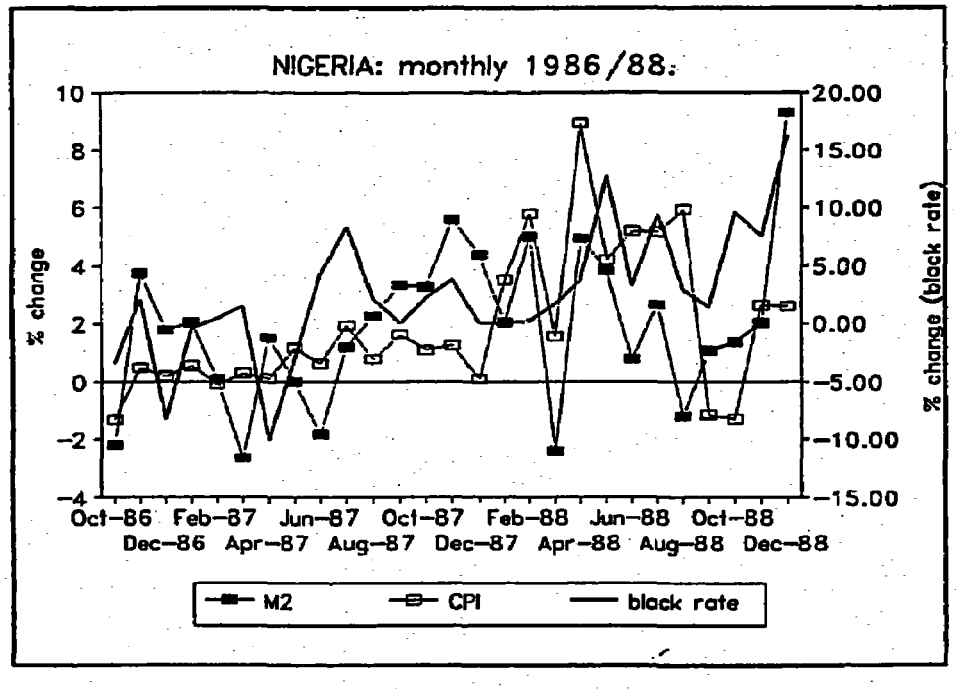

NIGERIA: 67 auctions.
ratio
k
variance ratio
std errors

FIGURE 4 a,b,c,d: Macroeconomic policy indicators and the free exchange rate.






GHANA: quarterly 1986/92.
% change
% change (M2)
16
14
12
10
8
6
4
2
0
-2
-4
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
8604
8704
8804
8904
9004
9104
8702
8802
8902
9002
9102
9202
M2
CPI
bureaux rate


NIGERIA: monthly 1986/88.
% change
% change (black rate)
10
8
6
4
2
0
-2
-4
20.00
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
Oct-86
Feb-87
Jun-87
Oct-87
Feb-88
Jun-88
Oct-88
Dec-86
Apr-87
Aug-87
Dec-87
Apr-88
Aug-88
Dec-88
M2
CPI
black rate

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